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“obstetrices. Verum id noluit mater puerpera.  
 “Pietati ejus obsecundavit fortuna. Lingua enim  
 “inferior paulatim emarcuit, et in exiguam piscoque  
 “haud majorem lingulam, quæ hodiernum manet,  
 “contracta est. Lingua interim superior ad justam  
 “crevit magnitudinem, quamplurimis longis pro-  
 “fundisque sulcis distincta, an vulneribus laniata,  
 “dicam! quæ parallelo situ posita una cum lingua  
 “creverunt, neque unquam coitura esse videntur.”  
 Nat. Nov. ix. 1664. Ob. 1694-5. Mart. 5. Æt. 31.

It appears by this Journal of himself that he was  
 always infirm and sickly. \*

XIV. *Upon the Sounds and Hearing of Fishes,*  
 by Jac. Theod. Klein R. P. Gedan. F.R.S.  
 or *Some Account of a Treatise, intituled, “An*  
 “Inquiry into the Reasons why the Au-  
 “thor of an Epistle concerning the Hear-  
 “ing of Fishes endeavours to prove they  
 “are all mute and deaf;” by Richard  
 Brocklesby M. D. F. R. S.

Read March 10.  
 1747-8.

OUR Author in the first place classes  
 them into two Orders, the first  
 hath Lungs, the other is furnish'd with Organs ana-  
 logous to Lungs, which we call Fish-Ears, or Gills:  
 All the Whale-Kind, the Dolphin, Porpoise, and  
 such like, have Lungs. There are two Families of  
 the second Class, to one of them belongs all that  
 Tribe,

\* See the Account of *Margaret Cutting*, who speaks without a  
 Tongue, in these *Transf.* N<sup>o</sup>. 484, p. 621.

Tribe, which have one, two, five, or nine Air-Holes, at the Back, or Sides of the Head, or in their *Thorax*, in which concealed Gills are found: The other Family comprehends all Kinds of Fishes, whose Gills are usually placed on each Side the Back of the Head. Our Author's Antagonist alleges, that all Fishes of both Orders are equally deaf; but that all Naturalists except Mr. *Reaumur* are of a contrary Opinion, that Fishes hear distinctly.

Our Author begins with an Air of Ridicule, and shews how far the Letter-writer is ignorant of the various Opinions, modern as well as antient. Our learned Countryman Mr. *Ray* thinks to reconcile these, by allowing that some hear, while others are deaf; but the greatest Part allow that Fishes actually hear; and most, except *Scheuchzer*, seem agreed about the auditory Passages: But the Letter-writer denies they have any Organs of Voice, merely upon the proverbial Authority, *Mute as a Fish*; hence he concludes they are likewise deaf. But in Answer, 'tis replied, the spouting Whale hath all its internal Organs, precisely similar to the Organs of Voice in other Creatures, and therefore they may answer the same Purposes, nay actually serve this End: For when the Whales in the *Greenland* Fishery are struck, they roar frequently so loud, as to be heard at two *French* Miles Distance.

But some of the first Family of our second Class, as the Skate, Lamprey, Conger, and others, our Author hath heard utter some kind of Noise; and gives his Opinion, that most Sorts of cartilaginous Fishes can do the same. From Analogy he argues, that as no Beast, from the Lion to the meanest Animal,

mal, nor from the Eagle to the humming Bird, but can utter a Voice, so he thinks the same general Law is observ'd in the Oeconomy of Fishes: But at the same time our Author here seems to lay too much Weight upon what he supposes final Causes, and metaphysical Arguments, which have in all Ages ruin'd Natural Philosophy.

But the Letter-writer queries, whether Fishes may not be mute in our Air, and yet capable of some Voice in their own Element. Our Author takes the Noise which Carp and such Fish make in hot Weather, on the Surface of the Water, to be a Voice: And this is most remarkable when the Male impregns the Row which the Female has before deposited; yet this is often heard, when the Fish is 6 or 7 Inches under Water. Our Author further enumerates many foreign Fishes, and particularly our Smelt, which put alive into Vinegar hisses very audibly.

The Letter writer had objected against Fishes, that they have no Occasion for Hearing, because they never copulate, as other Animals do: But our Author describes the Manner of Whales, which is performed as that of other Animals; and observes, that they bring forth their Young alive: These follow the Female, and suck Milk from the Teats, which are placed in them near the Organs of Generation; and in violent Storms the Dam takes her Off-spring into her Mouth, and protects them from Danger. This last is common to several of the Skate-kind.

The Letter-writer alleges, That Fish never sleep; but our Author assures us, all such as have Lungs do in the Night-time, thrusting up their Nostrils into

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the open Air. For others he cannot be positive, as their History is little known.

The Letter-writer premises two Questions; first, Whether Fishes have any Ears? or, If the Gills serve the same Purpose? and answers positively in the Negative to both: And therefore concludes they cannot hear. But our Author asserts, that Snakes, Frogs, Chameleons, and others of the Lizard-kind, actually hear, without any of the usual external *Apparatus* of Hearing. For though they want the Auricles and Ears, yet have they auditory Passages, by which Sound is convey'd, and even internal Organs, to which the *Meatus auditorius* reaches. But our Author farther asserts, that all the Whale-kind, and in general such Fishes as have Lungs, have likewise a *Meatus auditorius*, and the internal Organs of Hearing; and appeals to a public Dissection of a Porpoise, and another Fish of the Whale-kind, made by himself; in which the *Os petrosum*, with the other Parts of these Organs, had been separately shew'd; and calls in the concurrent Testimony of Dr. *Tyson*, in his Anatomy of a Porpoise.

Thus having satisfied us about such Fish as have Lungs, he goes on to consider the cartilaginous Species, such as the Skate, Ray, and kind of Lamprey, which have Organs of Generation, and copulate like Brutes; yet exclude the *Fætus* while yet in the Egg-State: And this from Analogy, that these, and in general all other Fish, as they have Organs which serve them for Lungs, so they may have what answers in others to the *Apparatus* of Hearing.

In Proof of this he asserts, that all Kinds of Fish but these which have Lungs, are always found to have

have Stones in their Heads naturally form'd, and invariably plac'd in the same Situation, being join'd to the contiguous Parts with Ligaments and Nerves, which take their Rise from the Substance of the Brain; and having examin'd the Head of a Pike minutely with a Microscope, he discover'd the auditory Pores in the Stones, and persuades himself, that three Pair of Stones are to be referr'd to this Use; therefore concludes, as there is some Analogy in the Organs, that all Fishes in some measure hear.

The Letter-writer farther objects, that Water is not the Medium of Sounds; and though Air is actually contain'd in all Water, yet it cannot be put into Undulations, any more than the circum-ambient Water; but that would require a much greater Vibration than the external Air can give. Thus, says he, if a Person immerge his Head a Foot under Water, he will hear nothing but a boiling Din; and however great a Noise is made in the open Air, the Event will be still the same; and if the Water itself be put into the most violent Agitation, the Person will discover no Odds in that Sensation of his Ears from what he perceived in the stillest Water. Hence he concludes Water incapable of transmitting Sounds. Our Author replies, That as Fishes are unanimously agreed to be capable of smelling, so, by Analogy, it is probable they have Hearing; for Odours are convey'd by the Air, as well as Sound. But he thinks the unnatural Position of a Man's Head immerg'd a Foot under Water may be some Cause for that confused Noise, and opposes the experimental Testimony of Abbè *Nollet* himself, who went different Depths under Water, to satisfy

himself how far Sounds could be convey'd in that Medium.

At four Inches under Water he heard the Sound of a Gun discharged, of a Clock striking, and of a Hunter's Horn : These, repeated at different Depths, were heard first at 4, then at 8, afterwards at 18 Inches, and lastly at two Foot. A Man's Voice was also heard in the same Manner.

At different Altitudes of Water, none of them exceeding two Feet, he could perfectly distinguish mixt Sounds, when two Bells were struck, or two Pipes sounded together.

He could distinguish under Water, very distinctly, Words utter'd aloud : And prov'd this Assertion, by declaring, when he came above Water, what was said while he was under it.

All Sounds were heard more faintly, and attenuated ; yet the Difference of the Sound, at 4 and 18 Inches Depth, was not answerable to the Difference of the Altitude of Water.

He observ'd at first, that momentary Sounds were not so well convey'd as continu'd ; yet he afterwards determin'd, at the same Depth, one Tap of a Drum-head, as plainly as a continued Round. This he thinks was the same in a Man's Voice, and the Sound of a Pipe ; but ingenuously owns, he was not fully satisfied in this Experiment ; and therefore does not lay as great Stress on its Certainty as on the former.

Lastly, he held his Head under the Surface of the Water, so as barely to cover him ; but could not hear the Clock strike, which was audible in the open Air at 45 Feet Distance, especially on a Plain.

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The Abbè therefore concludes, if Fishes do not actually hear, 'tis for want of proper Organs, and not because the Medium cannot convey Sounds.

Our Author mentions the common Notion of Carp, and other Fish, coming out of their Holes at the Sound of a Bell to be fed; and adds a Story, which Mr. *Boyle* somewhere relates, that near *Geneva* a Man had a Fish-pond, whose Banks were so high from the Plain on which it was, that one could not look over them into the Pond; and therefore it was impossible the Fish could see the Person; yet they were at any time conven'd at certain Sounds by the Gardener, in order to be fed, as a creditable Person asserts.

The Letter-writer, having made a high Partition in a Pond, watch'd while an Accomplice behind it made a very great Noise, and discharg'd a Gun, in order to frighten the Fish (if possible) that were playing on the Surface of the Water; but they did not give any Attention; yet as soon as ever they came in Sight, the Fish immediately made off.

Our Author thinks this Objection of little Weight, because the Question is not, whether Fishes, when they see nothing, can be frightened by Sounds only.

Upon the Whole, our Author shews himself an experienc'd and diligent Naturalist, and will (if I mistake not) be allow'd to have fully prov'd the Falsity of any Assertion, that all Fish are intirely mute and deaf.